REMARKS

Claims 1-13 are currently pending in this application. No claims are amended herein. Claims 1-13 stand rejected under 35 U.S.C. § 103 as unpatentable over Ohashi ("Improved CIGS thin-film solar cells by surface sulfurization using In_2S_3 and sulfur vapor") or Turcu ("Composition dependence of defect energies and band alignment in the $Cu(In_{1-x}Ga_x)(Se_{1-y}S_y)_2$ alloy system").

It is well settled that the Examiner "bears the initial burden of presenting a *prima facie* case of unpatentability..." *In re Sullivan*, 498 F.3d 1345 (Fed. Cir. 2007). Until the Examiner has established a *prima facie* case of obviousness, the Applicant need not present arguments or evidence of non-obviousness. To establish a *prima facie* case of obviousness, the Examiner must establish at least three elements. First, the prior art reference (or references when combined) must teach or suggest all of the claim limitations: "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 165 U.S.P.Q. 494, 496 (CCPA 1970); *see also M.P.E.P. § 2143.03.* Second, there must be a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 U.S.P.Q. 375 (Fed. Cir. 1986); *Pharmastem Therapeutics v. Viacell, Inc.*, 491 F.3d 1342, 83 U.S.P.Q.2d 1289 (Fed. Cir. 2007); *see also M.P.E.P. § 2143.02.* And finally, the Examiner must articulate some reason to modify or combine the cited references that renders the claim obvious. Merely establishing that the claimed elements can be found in the prior art is not sufficient to establish a *prima facie* case of obviousness. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007).

Applicants also note that "[i]nherency, however, may not be established by probabilities or possibilities. The fact that a given thing ***may*** result from a given set of circumstances is not sufficient." *In re* Oelrich, 212 U.S.P.Q. 323, 326 (C.C.P.A. 1981). *See also* Tintec Industries, Inc. v. Top-USA Corp., 63 U.S.P.Q.2d 1597, 1599 (Fed. Cir. 2002). When relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic ***necessarily flows*** from the teachings of the applied prior art. *Ex parte* Levy, 17 U.S.P.Q.2d. 1461, 1464 (Bd. Pat. App. & Inter. 1990)(emphasis added).

The Examiner found that:

> Ohashi discloses the features including the claimed alloy composition and X-ray diffraction patterns (Figure 3 and section 3). Turcu discloses the features including the claimed alloy composition and X-ray diffraction patterns (abstract and Figures 4-10). Therefore, when prior art compounds essentially bracketing the claimed compounds in structural similarity are all known, one of ordinary skill in the art would clearly be motivated to make those claimed compounds in searching for new products in the expectation that compounds similar in structure will have similar properties.

Office Action at page 3.

First, Applicant notes that the products of Turcu and Ohashi are not identical in structure or composition as found by the Examiner. Claim 1 recites "the alloy being characterized by an x-ray diffraction pattern (XRD) having a main [112] peak at a 2θ angle ($2\theta_{(112)}$) of from 26° to 28° for Cu radiation at 40kV, wherein a glancing incidence x ray diffraction pattern (GIXRD) for a glancing angle of from 0.2° to 10° reflects an absolute shift in the $2\theta_{(112)}$ angle of less than 0.06°." This feature is not disclosed inherently or explicitly in Turcu or Ohashi. Further, as discussed in greater detail below, this is more than an obvious variation of Turcu or Ohashi.

Applicant also disagrees with the Examiner's finding that the claimed features were bracketed by Ohashi and Turcu. This finding is incorrect because, as discussed above, Turcu and Ohashi disclose different structures from the recited features. This is more than a range, single variable, or composition to just select. Further, the methods disclosed in Turcu and Ohashi have well known problems and are not capable of making an alloy with the recited features, as discussed in greater detail below.

The problems and limitations in the methods of Turcu and Ohashi are well documented. Prior to the time of the present application there were three main prior art techniques for making chalcopyrite films:

1. chemical reaction of thin film metallic precursors comprising Cu(in-Ga) to selenium (Se) and/or sulfur (S) containing atmospheres, either in gaseous or vapor form
2. Rapid thermal processing (RTP) of stacked elemental layers comprising Cu-In-Ga-Se in sulfur (S) containing atmospheres.

3. Elemental evaporation of Cu, In, Ga, and Se from thermal sources, which allow independent controlled fluxes of the respective elements. (gradients)

These methods are discussed in greater detail below with respect to the methods disclosed in Ohashi and Turcu

Rejections based on Ohashi

With regards to Ohashi, Applicant respectfully disagrees with the Examiner's characterization. Applicant respectfully submits that the skilled artisan would not arrive at the recited features because of clear inconsistencies in the data and known limitations of the deposition techniques used in Ohashi.

Ohashi discloses surface sulfurization of CIGS thin films using sequential evaporation of In_2S_3 after CIGS deposition and annealing of CIGS thin films in sulfur vapor. These two-stage sulfurization techniques are known in the art to not produce homogenous films. Delsol et al, Fig. 6, pp. 594-595 ("The profiles indicate the presence of more copper and gallium near the Mo substrate and preferential indium diffusion towards the free surface of the CIGSS layer. Furthermore, the presence of several humps indicates the non-uniform distribution of elements with the layer."), attached in the Appendix hereto.

Ohashi discloses that the CIGS films were grown in the same deposition run and divided into two parts for the experiments (page 265). The results for sequential evaporation of In_2S_3, process A are illustrated in Fig. 1. Fig. 1(b) clearly shows the presence of a CIGS (112) peak at about 26.85° and a CIGSS (112) peak at about 27.25°. The CIGS peak shows a higher intensity peak for the 1° and 10° readings because these angles measure the properties of the alloy below the surface. The 0.1° reading measures the properties of the material on the surface of the alloy and can contain a lot of noise as shown in Fig. 1(b) and Fig. 3(a). Also, the skilled artisan would understand that it is difficult to get reliable data from angles of 0.1°. Fig. 1(a) shows an absolute shift in GIXRD data of about 0.4 between the values of the CIGS (112) peak and CIGSS (112) peak, which is well above the value recited in Claim 1. This shows that the data for the alloy formed by process A does not meet the recited features of Claim 1 because the GIXRD shift is greater than 0.06°.

Fig. 3(a) also does not disclose the features recited in Claim 1. In particular, there are a number of inconsistencies in Fig. 3(a). First, Fig. 3(a) only shows a CIGS (112) peak despite the clear presence of 18% sulfur, as shown in Fig. 3(b). The skilled artisan would expect the presence of sulfur in the alloy to show a CIGSS peak for GIXRD at 0.1° as shown in Fig. 1(b). The skilled artisan would also appreciate that the amount of sulfur present in the film as confirmed in Fig. 3(a) is well within the detection limit of GIXRD. Further, The CIGSS peak expected by the skilled artisan would not be within the range recited in Claim 1.

Further, the skilled artisan would expect the CIGS (112) peak to be at 26.85° instead of 27° for the GIXRD values of 1° and 10° because the same CIGS material was used in both process A and B. The surface sulfurization clearly incorporates sulfur into the surface of both alloys as shown in Figs. 1(a), 1(b), 3(a), and 3(b), thereby forming heterogeneous alloys. The skilled artisan would appreciate that a heterogeneous alloy is not capable of producing an "alloy being characterized by an x-ray diffraction pattern (XRD) having a main [112] peak at a 2θ angle ($2\theta_{(112)}$) of from 26° to 28° for Cu radiation at 40kV, wherein a glancing incidence x ray diffraction pattern (GIXRD) for a glancing angle of from 0.2° to 10° reflects an absolute shift in the $2\theta_{(112)}$ angle of less than 0.06°" as recited in Claim 1. Accordingly, Applicant respectfully requests withdrawal of this rejection for at least this reason.

Further, Ohashi contains no GIXRD data for 0.2° to 1° and the films are made by different methods. Given the clear inconsistencies discussed above, the skilled artisan would appreciate that an alloy "wherein a glancing incidence x ray diffraction pattern (GIXRD) for a glancing angle of from 0.2° to 10° reflects an absolute shift in the $2\theta_{(112)}$ angle of less than 0.06°" is not inherently taught by Ohashi. The Examiner has not provided sufficient reasoning to show that this necessarily flows from the teachings of Ohashi as required. *Ex parte* Levy, 17 U.S.P.Q.2d. 1461, 1464 (Bd. Pat. App. & Inter. 1990).

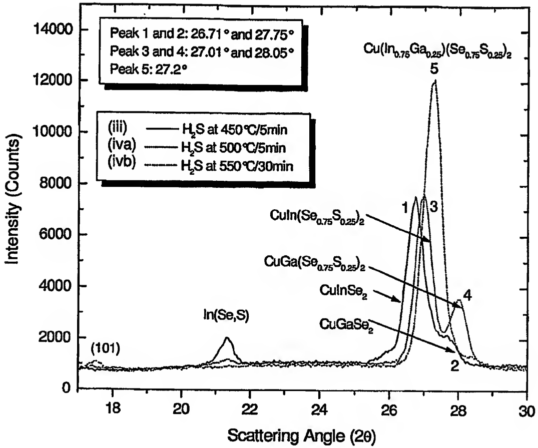
Ohashi clearly discloses a compositional gradient of sulfur in Fig. 3(b), accordingly the skilled artisan would not expect it to inherently teach the recited features and also would expect lattice mismatches and structural defects in the lattice throughout the depth of the alloy that would negatively impact the performance of a photovoltaic device using such an alloy. See paragraphs [0020]-[0024] of the specification as published.

Moreover, one skilled in the art would have no reasonable expectation of success. *Pharmastem Therapeutics v. Viacell, Inc.* 491 F.3d 1342, 83 U.S.P.Q.2d 1289 (Fed. Cir. 2007) (after *KSR*, Federal Circuit finds claims non-obvious for lack of indication of reasonable expectation of success for asserted combination). Ohashi only discloses the two stage method for depositing the thin films. Ohashi fails to disclose how to overcome the problems known in the art with the two-stage process. There is no reason to deposit a film with the claimed features and no expectation of success to deposit a film with the claimed features by the methods disclosed in Ohashi. Further, the skilled artisan would have no reasonable expectation of success because the alloy formed in Ohashi is heterogeneous and would not be expected to produce the recited GIXRD pattern because of the heterogeneous composition and presence of multiple phases. This is not an obvious variation because "[t]o the extent that an art is unpredictable, as the chemical arts often are, *KSR*'s focus on these 'identified, predictable solutions' may present a difficult hurdle because potential solutions are less likely to be genuinely predictable." *Eisai Co. Ltd. v. Dr. Reddy's Laboratories, Ltd*, Nos. 2007-1397, -1398, slip opinion at pg 8 (Fed Cir. 2008). Again, there is no teaching or suggestion in Ohashi for how to overcome the problems known in the art with the two-stage method to achieve a film with the recited properties.

A supporting reference is attached in an Appendix to this response and in an IDS submitted concurrently. The reference materials further support that the process of Ohashi would not inherently produce the recited GIXRD data. First, the process of Ohashi is closely related to the two stage process of selenization and sulfurization disclosed by Kushiya (submitted in a previous IDS). Films deposited by the two-stage method are studied in greater detail in Delsol et al, attached in the Appendix to this response. In the analysis of the XRD data, Delsol found that the "XRD pattern revealed that the CIGSS layers are polycrystalline and preferentially oriented along (112). All the peaks related to $CuInSe_2$ have a shoulder, which corresponds to a mixture of other phases such as $CuInS_2$ or $CuGaSe_2$." Delsol, page 589. Delsol further discloses that "[a]nalysis of the Raman spectra shows the existence of at least five different phases such as $CuInSe_2$ and $CuInS_2$". Delsol, page 590; Fig. 2. Delsol further found with regard to the bulk composition that the "profiles indicated the presence of more copper and gallium near the Mo substrate and preferential indium diffusion towards the free surface of the CIGSS layer.

Furthermore the presence of several humps indicates the non-uniform distribution of elements within the layer." Id. at page 594-595; Fig. 6.

As shown below in Figure 3 of the present application, the properties and presence of the different phases of materials can affect the scattering angle. Delsol's analysis of films formed by the two-step method found that the film contained $CuInSe_2$, $CuInS_2$, or $CuGaSe_2$. As shown below in Fig. 3, the presence of these materials at the surface or in the bulk of the alloy will shift the scattering angle of the GIXRD data. Accordingly, the film formed by the methods disclosed in Ohashi fails to explicitly or inherently disclose or make obvious an "alloy being characterized by an x-ray diffraction pattern (XRD) having a main [112] peak at a 2θ angle ($2\theta_{(112)}$) of from 26° to 28° for Cu radiation at 40kV, wherein a glancing incidence x ray diffraction pattern (GIXRD) for a glancing angle of from 0.2° to 10° reflects an absolute shift in the $2\theta_{(112)}$ angle of less than 0.06°".



Accordingly, Applicants respectfully submit that Ohashi does not make Claim 1 obvious because Ohashi fails to disclose all of the features, provides no reason to modify the film to arrive at the features, and provides no disclosure of how to modify the film to arrive at the features.

Rejections based on Turcu

Turcu discloses a single stage co-evaporation process for forming a CIGSS alloy. This method is discussed in paragraphs [0027]-[0028] of the specification as published. Alloys made by co-evaporation are typically graded and not homogenous. This is supported by the following statement in Turcu: "[a]t this point in time, we have to bear in mind that the very surface region of $Cu(In,Ga)(Se,S)_2$ thin film has stoichiometry and physical properties significantly different form the bulk material". Turcu, page 1398. Thus, the film CIGSS disclosed in Turcu is heterogeneous.

The Examiner found that "Turcu discloses the features including the claimed alloy composition and X-ray diffraction patterns (abstract and Figures 4-10)." Office Action at page 3. This is clearly incorrect because Turcu fails to disclose ***any*** X-ray diffraction patterns, much less GIXRD data. Therefore, Turcu fails to disclose an "alloy being characterized by an x-ray diffraction pattern (XRD) having a main [112] peak at a 2θ angle ($2\theta_{(112)}$) of from 26° to 28° for Cu radiation at 40kV, wherein a glancing incidence x ray diffraction pattern (GIXRD) for a glancing angle of from 0.2° to 10° reflects an absolute shift in the $2\theta_{(112)}$ angle of less than 0.06°" as recited in Claim 1. Accordingly, Applicant respectfully requests withdrawal of this rejection for at least this reason.

Further, the Examiner has provided no basis in fact and/or technical reasoning to reasonably support a determination that the recited characteristics necessarily flow from the teachings of the art. *Ex parte* Levy, 17 U.S.P.Q.2d. 1461, 1464 (Bd. Pat. App. & Inter. 1990). The only evidence that the examiner has provided are conclusory statements alleging that Turcu contains X-ray diffraction patterns, which are clearly not there. Further, Turcu discloses that the surface of the alloy is different from the bulk of the alloy. Accordingly, the skilled artisan would not expect the alloys of Turcu to have the recited GIXRD pattern. Accordingly, Applicants

submits that the features recited in Claim 1 are not inherently taught by Turcu. Thus, Applicant respectfully requests that this rejection be withdrawn for at least this reason as well.

Further, there is no reason to deposit a film with the claimed features and no expectation of success to deposit a film with the claimed features by the methods disclosed in Turcu. Further, the skilled artisan would have no reasonable expectation of success because the alloy formed in Turcu is heterogeneous and would not be expected to produce the recited GIXRD pattern because of the heterogeneous composition and presence of multiple phases. Thus, Applicant respectfully requests that this rejection be withdrawn for at least this reason as well.

Dependent Claims

The Examiner further found the features of Claims 6-13 to be inherent, citing caselaw requiring that the claimed and prior art products be identical or substantially identical in structure or composition, or be produced by identical or substantially identical processes. As discussed above, the products are not produced by the same methods and the products are clearly different. Accordingly, Applicant submits that the caselaw is not applicable to the current facts and that the Examiner has not met his burden to show that the features of even Claim 1 must necessarily flow from the cited references, as required.

The cited references also fail to disclose the features of the dependant claims. In particular, Ohashi and Turcu fail to disclose or make obvious any of the recited variance in d-spacing values. Applicant notes that Ohashi and Turcu fail to disclose any d-spacing values, much less "wherein the alloy has a crystal structure comprising a lattice of unit cells, wherein all crystallographic planes of the unit cells show a variance in d-spacing of less than 0.01Å" or "wherein the alloy has a crystal structure comprising a lattice of unit cells, wherein all crystallographic planes of the unit cells show a variance in d-spacing of less than 0.001Å" as recited in Claims 2 and 8, respectively. Also, these features are not inherent for the reason discussed above and there is no reason to modify to achieve the recited features or expectation of success. Accordingly, Applicant request that the rejections of Claims 2 and 8 be withdrawn for at least this reason.

Ohashi and Turcu also fail to teach the features of Claim 3. Claim 3 recites in part "wherein the element concentration of elements A, B, C, D, and E, as characterized by XPS

depth profiling, is substantially uniform through the alloy". As discussed above, the composition of the films in Ohashi and Turcu are heterogeneous and have composition gradients. Therefore Ohashi and Turcu fail to disclose this feature. Accordingly, Applicant request that the rejections of Claims 2 and 8 be withdrawn for at least this reason.

Additionally, Applicants submit that Claims 4-7 and 9-13 also define over the cited references, not only because they depend from Claim 1 but also on their own merit.

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application.

Co-Pending Applications of Assignee

Applicant wishes to draw the Examiner's attention to the following co-pending applications of the present application's assignee.

Serial Number	Title	Filed
10/568,227	METHOD FOR THE PREPARATION OF GROUP IB-IIIA-VIA QUATERNARY OR HIGHER ALLOY SEMICONDUCTOR FILMS	May 17, 2006

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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